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ABSTRACT

This invention relates generally to a building element (1) which is roll-formed from thin, high-tensile, preferably galvanised, steel strip having a thickness of for example 1.2 mm. The element (1) comprises a web (3) and two longitudinal edge flanges (4 and 5). The web (3) is provided with an array of longitudinally spaced apart stiffening apertures (14). Stiffening flanges (15) are formed contiguously about the edges of the apertures (14). Flange (4) comprises walls (6 to 9) and in this embodiment the flange (4) projects to both sides of the web (3). In assembly, two substantially identical channel sections are engaged or in this example interlocked with each other to form the boxed beam.

AUSTRALIA

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STANDARD PATENT

Applicant(s):

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Invention Title:

STRUCTURAL MEMBER

STRUCTURAL MEMBER

The present invention relates generally to building structural members and relates particularly but not exclusively to elongate building elements of the kind that are cold roll-formed from sheet steel strip.

According to one aspect of the present invention, there is provided an elongate building element comprising a web and opposing longitudinal edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent apertures, the web portions extending between the opposing flanges and each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an intermediate waisted portion, each aperture being provided with a stiffening flange surrounding its edge, wherein at least one of the opposing flanges includes a first flanged wall portion which extends outwardly from the web and a second flange wall portion which extends inwardly so as to be dispersed over said wall portion being spaced from the first wall position, wherein in use said at least one opposing flange is capable of being fastenable with relative ease with a fastener being able to be driven into the flange to pierce both the first and second wall portions.

In particular at least one of the opposing flanges is nailable thereby being capable of being fastenable with relative ease. It should be appreciated that screwing of the flange is also considered to be within the scope of this phrase.

Preferably, the opposing longitudinal edge flanges are constructed of a relatively thin gauge steel strip material. The provision of the pair of opposing spaced apart flange walls of

relatively thin gauge steel strip facilitates fastening and in particular enhances fastener retention.

According to another aspect of the present invention an elongate building element comprising a channel section having a web and opposing longitudinal edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent apertures, the web portions extending between the opposing flanges and each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an intermediate waisted portion, each aperture being provided with a stiffening flange surrounding its edge, the channel section being configured to engage an adjacent elongate building element so as to form an elongate boxed element.

According to a further aspect of the present invention there is provided an elongate boxed structural element formed of two channel sections each having a web and opposing edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent apertures, the web portions extending between the opposing flanges, each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an intermediate waisted portion, each aperture being provided with a stiffening flange surrounding its edge, the channel sections engaging each other to form the boxed structural element.

Preferably at least one of the edge flanges of one of the channel sections includes a free edge portion which engages with the corresponding edge flange of the other

channel section so that the channel sections interlock to form the boxed structural element. Preferably the free edge portions of the opposing edge flanges are directed toward each other thereby assisting in interlocking of the channel sections.

More preferably the interlocked channel sections together form the opposing edge flanges which are thus each of a double-skin construction. Advantageously the double-skin edge flanges further enhance fastener retention.

Preferably the boxed structural element further comprises fixing means cooperating with the channel sections so as to fix the channels together and prevent longitudinal shear therebetween. Generally, the fixing means includes a plurality of fasteners passing through a portion of engaging flanges of the edge flanges. Fixing means are particularly advantageous when the boxed structural element is used as a purlin, such as a floor purlin, where positive fixing of the channel sections is required. Alternatively, the fixing means are in the form of clinching or spot welding.

According to yet a further aspect of the invention, there is provided a method of fabricating a boxed structural element, the method involving the steps of:

(i) providing a pair of channel sections each having a web and opposing longitudinal edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent apertures, the web portions extending between the opposing flanges and, each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an

intermediate waisted portion each aperture being provided with a stiffening flange surrounding its edge; and

(ii) engaging the channel sections to form the boxed structural element whereby free edge portions of the edge flanges of one channel section engage with respective adjacent edge flanges of the other channel section.

It is preferred that the edge flanges project laterally to both sides of the web.

In preferred embodiments each of the edge flanges are roll-formed to provide a free edge portion which in assembly of the box structural element is brought into contact with one side of a flange wall of a complementary channel section. The contact areas are secured together by fixing means disposed intermittently at spaced intervals longitudinally along each free edge portion.

It is preferred that the stiffening apertures are round and that the apertures form a major portion of the web.

It is preferred that the building element is cold-roll formed by passing a steel strip through a roll-forming apparatus to form a channel section having an elongate web and edge flanges, passing the channel section to a punching apparatus to form an array of round apertures in the web, and then passing the channel section to a

pressing apparatus to form the stiffening flange surrounding the edge of each of the apertures.

Generally the boxed structural element is a boxed beam, stud, or purlin of the described construction having flanges of enhanced resistance to bending and/or webs of enhanced resistance to shear by comparison with conventional I-beams or channel sections made from similar strip.

Provision of the edge flanges that project laterally in both directions from the web enhances the ability of the element to carry external loads and transfer those loads to the web in the plane of the web, thereby loading the web more nearly in direct shear than would otherwise be the case.

Provision of stiffening apertures in the web enhances the strength of the web in response to shear and/or tension loads, than would otherwise be the case.

By way of example, an embodiment of the above described invention is described in more detail hereinafter with reference to the accompanying drawings:

Figure 1 is a side elevation of a portion of a boxed structural element according to one embodiment of the invention;

Figure 2 is an end elevation of the structural element of Figure 1; and

Figure 3 is an end elevation view of an elongate building element being a component of the boxed structural element.

The illustrated building element 1 as shown in figure 3 may be roll-formed from thin, high-tensile, preferably galvanised, steel strip having a thickness of, for example 1.2 mm. It may be roll-formed by the single

passage of an initially flat strip of appropriate width through a series of forming rolls which successively modify the shape of the strip passing through them to form a channel section.

The element 1 comprises a web 3 and two longitudinal edge flanges 4 and 5 respectively. The web 3 is provided with an array of longitudinally spaced apart stiffening apertures 14. The array of spaced apart apertures 14 is cut into the web 3 of the channel section, and inwardly projecting substantially perpendicular stiffening flanges 15 formed contiguously about the edges of the apertures 14. The stiffening apertures 14 are round and form a major portion of the web 3. The stiffening aperture flanges 15 may, for example, extend inwardly a distance (S) of about 12mm from the edge of the aperture 14

The building element 1 is cold-roll-formed by passing a steel strip through a roll-forming apparatus to form the channel section as mentioned above then passing the channel section to a punching apparatus to form the array of round stiffening apertures 14 in the web 3, and then passing the channel section to a pressing apparatus to form the inwardly projecting substantially perpendicular stiffening flange 15 surrounding the edge of each aperture 14.

In other embodiments the order in which the operations are performed on the strip may vary.

Flange 4 comprises walls 6 to 9 respectively. As illustrated flange 4 projects to both sides of the web. The flange 4 projects outwardly a distance (X) of, for example, about 8 mm from the plane of the web 3 and inwardly a distance (F-X) of about 40mm from the plane of the web 3. Flange wall 6 is integral with both the web 3

and flange wall 7, and flange wall 8 is integral with both flange wall 7 and a free edge portion 9 of the flange 4.

In assembly, two substantially identical channel sections are engaged or in this example interlocked with each other to form the boxed beam in accordance with a preferred embodiment of the invention as illustrated in figures 1 and 2.

The flange wall 7 of one channel section and the free edge portion 9 of the other channel section are secured flatly together by a row of closely spaced apart fastening means in the form of, for example, clinches 18 adapted to hold the wall 7 and free edge portion 9 in contact and to transfer shear loads therebetween. Thus each of the channel sections effectively become part of and contribute to the strength of, the webs 3 of the structural member. Although preferred because of their simplicity and ease of formation, the clinches 18 may be replaced in other embodiments by other conventional fastening means, for example, line or spot welds, rivets, screw fasteners, or nails.

The flange wall 8 is relatively broad and preferably flat so as to present a substantial load bearing area to any item to be supported by the member that extends across it. In one embodiment, the structural element is of a boxed stud configuration where cladding is nailed or otherwise fastened to the boxed stud to provide wall panels. Alternatively, the structural element is a purlin, such as a floor purlin to which a series of transverse battens or boards are to be fixed. The spaced opposing walls, such as 6 and 8, provide a pair of sheet elements which are piercable by a fastener for secure fastener of the cladding or battens to the boxed stud or purlin, respectively. This feature provides enhanced fastener or nail retention.

The flange 5 comprises flange walls 10 to 13 respectively and on a mirror image of flange walls 6 to 9 of flange 4. Wall 12 is integral with the free edge portion 13, and the edge portion 13 is clinched to flange wall 11 of the other channel member by clinches 18. Both of the free edge portions 9 and 13 are directed toward each incorporated in the respective webs of the composite roll-formed boxed structural element. The free edge portions 9 and 13 assist in interlocking of the channel sections so as to form the boxed structural element. In this embodiment one or both of the opposing edge flanges 4 and 5 of one of the channel sections are resiliently deformed to receive and capture the other channel section.

The preferred embodiment illustrated in Figures 1 to 3 inclusive is directed to a boxed beam for use in domestic flooring and typical profile dimensions are listed below:

Boxed Beam Depth D mm	Element Depth D' mm	Aperture Diameter C mm	Element Width W' mm	Boxed Beam Width W mm	Element Feedwidth mm
250	249.25	185	250	70	250
200	199.25	135	200	200	200
150	149.25	95	150	150	150
100	99.25	45	100	100	100

It would be appreciated that modification to the invention can be readily made without departing from the spirit and scope of the invention. For example, the thickness of the strip may be as small as possible commensurate with the load rating requirements of the beam in a flooring to which it is applied and sufficiently thick to minimise the risk of catastrophic failure due to

unintended or excessive tensile or compressive stresses applied to the beam.

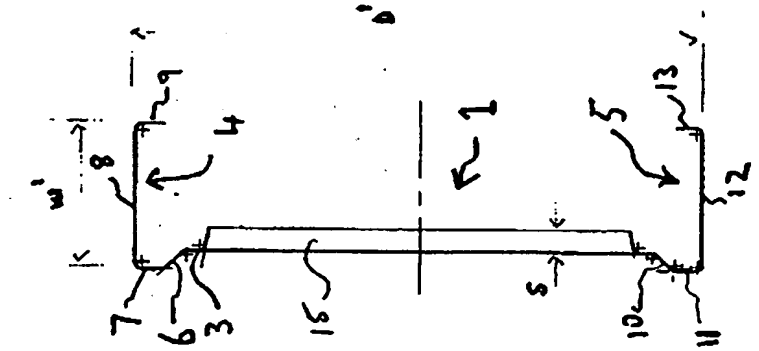

FIG. 3

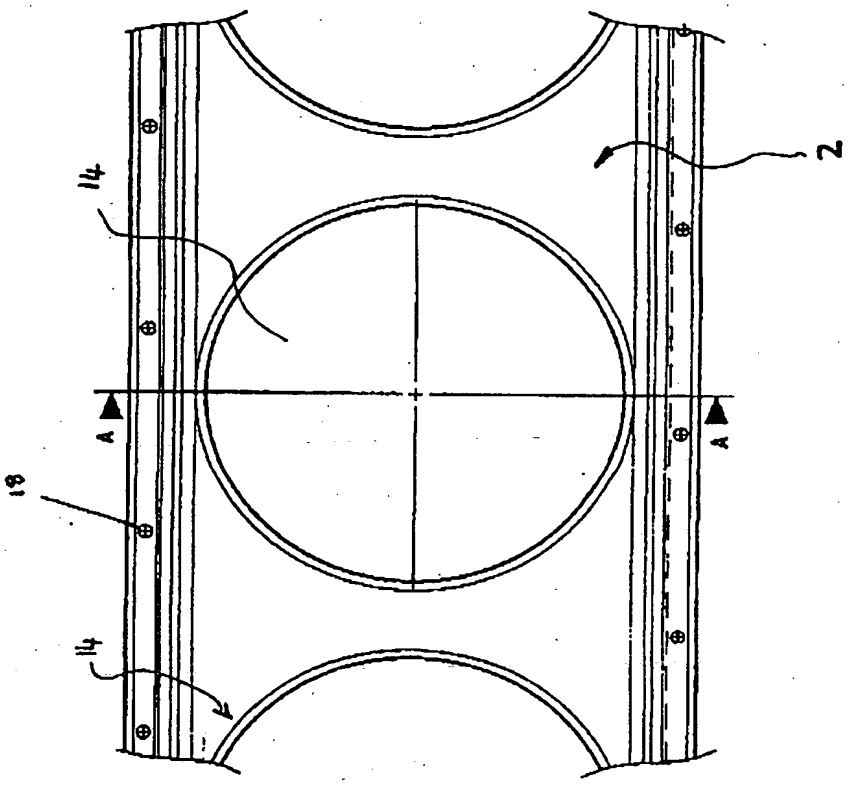

FIG. 1

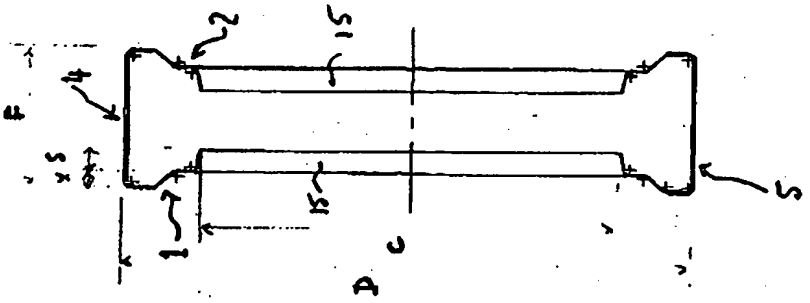

FIG. 2

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An elongate building element comprising a web and opposing longitudinal edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent apertures, the web portions extending between the opposing flanges and each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an intermediate waisted portion, each aperture being provided with a stiffening flange surrounding its edge, wherein at least one of the opposing flanges includes a first flanged wall portion which extends outwardly from the web and a second flange wall portion which extends inwardly so as to be dispersed over said wall portion being spaced from the first wall position, wherein in use said at least one opposing flange is capable of being fastenable with relative ease with a fastener being able to be driven into the flange to pierce both the first and second wall portions.

2. An elongate building element as defined in claim 1 wherein at least one of the opposing flanges is nailable thereby being capable of being fastenable with relative ease.

3. An elongate building element as defined in claim 1 or 2 wherein the opposing longitudinal edge flanges are constructed of a relatively thin gauge steel strip material.

4. An elongate building element comprising a channel section having a web and opposing longitudinal edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent

apertures, the web portions extending between the opposing flanges and each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an intermediate waisted portion, each aperture being provided with a stiffening flange surrounding its edge, the channel section being configured to engage an adjacent elongate building element so as to form an elongate boxed element.

6. An elongate boxed structural element formed of two channel sections each having a web and opposing edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent apertures, the web portions extending between the opposing flanges and each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an intermediate waisted portion each aperture being provided with a stiffening flange surrounding its edge, the channel sections engaging each other to form the boxed structural element.

7. An elongate boxed structural element as defined in claim 6 wherein one of the edge flanges of one of the channel sections includes a free edge portion which engages with the corresponding edge flange of the other channel section so that the channel sections interlock to form the boxed structural element.

8. An elongate boxed structural element as defined in claim 7 wherein the free edge portions of the opposing edge flanges are directed toward each other thereby assisting in interlocking of the channel sections.

9. An elongate boxed structural element as defined in any one of claims 6 to 8 wherein the interlocked channel sections together form the opposing edge flanges which are thus each of a double-skin construction.

10. An elongate boxed structural element as defined in any one of claims 6 to 9 further comprising fixing means cooperating with the channel sections so as to fix the channels together and prevent longitudinal shear therebetween.

11. An elongate boxed structural element as defined in claim 10 wherein the fixing means includes a plurality of fasteners passing through a portion of engaging flanges of the edge flanges.

12. An elongate boxed structural element as defined in claim 10 wherein the fixing means are in the form of clinching or spot welding.

13. An elongate building element or an elongate boxed structural element as defined in any one of the preceding claims wherein the stiffening apertures are round and form a major portion of the web.

14. A method of fabricating a boxed structural element, the method involving the steps of:

(i) providing a pair of channel sections each having a web and opposing longitudinal edge flanges, the web including an array of longitudinally spaced apart stiffening apertures configured so that a plurality of web portions are disposed between adjacent apertures, the web portions extending between the opposing flanges and each web portion being shaped generally as an hourglass having opposite enlarged portions adjacent respective ones of the flanges and an

intermediate waisted portion each aperture being provided with a stiffening flange surrounding its edge; and

(ii) engaging the channel sections to form the boxed structural element whereby free edge portions of the edge flanges of one channel section engage with respective adjacent edge flanges of the other channel section.

15. A method of fabricating a boxed structural element as defined in claim 14 wherein the edge flanges project laterally to both sides of the web.

16. A method of fabricating a boxed structural element as defined in claim 14 or 15 wherein each of the edge flanges are roll-formed to provide a free edge portion which in assembly of the box structural element is brought into contact with one side of a flange wall of a complementary channel section.

17. A method of fabricating a boxed structural element as defined in claim 16 wherein the contact areas are secured together by fixing means disposed intermittently at spaced intervals longitudinally along each free edge portion.

18. A method of fabricating a boxed structural element as defined in any one of claims 14 to 16 wherein each of the pair of channel sections is cold-roll formed by passing a steel strip through a roll-forming apparatus to form said channel section having the elongate web and the edge flanges, passing the channel section to a punching apparatus to form the array of stiffening apertures in the web, and then passing the channel section to a pressing apparatus to form the stiffening flange surrounding the edge of each of the apertures.

19. An elongate building element or a boxed structural element substantially as herein described with reference to the accompanying drawings.

20. A method of fabricating a boxed structural element substantially as herein described with reference to the accompanying drawings.

Dated this 25th day of February 2003
BHP STEEL LIMITED
By their Patent Attorneys
GRIFFITH HACK

EDITORIAL NOTE

Application Number: 48840/99

Claim 5 has been deleted.

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